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Review of the usage of socio-economic indicators on the environmental impact of fishing activities

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Project no. 513754

INDECO

Development of Indicators of Environmental Performance of the Common Fisheries Policy

Specific Targeted Research Project of the Sixth Research Framework Programme of the EU on 'Modernisation and sustainability of fisheries, including aquaculture-based production systems', under 'Sustainable Management of Europe's Natural Resources'

Review of the usage of socio-economic indicators on the environmental impact of fishing activities

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[FINAL]

The INDECO project

The purpose of this Co-ordination Action is to ensure a coherent approach to the development of indicators at EU level, in support of environmental integration within the CFP and in the context of international work on indicators. The principal objectives of INDECO are:

1. to identify quantitative indicators for the impact of fishing on the ecosystem state, functioning and dynamics, as well as indicators for socio-economic factors and for the effectiveness of different management measures;
2. to assess the applicability of such indicators; and
3. to develop operational models with a view to establishing the relationship between environmental conditions and fishing activities.

A consortium of 20 research organisations from 11 EU Member States is implementing INDECO. An Advisory User Group will provide a link between the researchers and policy makers, managers and stakeholders.

More information on INDECO can be found on the project's website:

<http://www.ieep.org.uk/projectMiniSites/indeco/index.php>

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1 INTRODUCTION

The objective of Work Package 6 of the INDECO Concerted Action is to review and analyse the utility of socio-economic indicators in fisheries management, with reference to the impact of fishing on the environment. On the basis of a strategic review and comparative case-studies (North Sea and Mediterranean Sea), it is intended to understand the existing usage of socio-economic indicators, to identify critical gaps and to make recommendations for future development of appropriate methods and their application. A key aspect of the work will be to broaden the perspective on socio-economic analysis into the key domains of policy development and institutional change (with reference to fisheries management systems), and how appropriate stakeholder participation and feedback might bring this about.

There are three main components to this work. The first component (INDECO Deliverable Number 8) will review the existing use of socio-economic indicators that have been used to understand the impact of fishing on marine ecosystems. The initial focus will be to clarify the conceptualisation of the relationship between natural and social science views of fisheries, and to understand the ways in which natural and social science information has been used and integrated in the past. The choice and purpose of socio-economic indicators (however defined) in general within the context of fisheries will be reviewed.

The second component of the work (INDECO Deliverable Number 14) will involve two comparative case studies to evaluate the existing utility and future possibilities for the use of socio-economic indicators in the study of the impact of fishing on ecosystem state. The case-studies will adopt a 3-phased approach to investigate and evaluate: (a) the use of socio-economic indicators to understand the linkages between ‘driving forces’ for increased fishing effort; (b) the use of socio-economic indicators to document and understand the casual chain between such factors as investment in fishing and new technology, and the state of the environment; (c) the use of socio-economic indicators to document and understand the nature of policy responses to environmental impact from fisheries. Particular attention will be given to the extent to which socio-economic indicator information can facilitate stakeholder participation in decision-making and institutional change.

The third component (INDECO Deliverable Number 18) will draw upon the review and the comparative case studies to identify and analyse important gaps in the usage of socio-economic information for the study of fishing impact on ecosystems. The outcome of this analysis will be a series of recommendations to increase the utility of socio-economic information through appropriate and innovative methods and their applications. Particular attention will be given to the need to broaden the perspective on socio-economic analysis into the key domains of policy development and institutional change (with reference to fisheries management systems), and how this might be brought about by appropriate stakeholder participation and feedback.

The present literature review report presents the evolution and purpose of socio-economic indicators particularly in the EU CFP context (Section 2). This is followed by an assessment of the reference frameworks for the elaboration of sector specific sustainability indicators developed by international organizations such as FAO, OECD and ICES and the framework adopted and practised in Australia (Section 3).

2 CONTEXT AND PURPOSE OF SOCIO-ECONOMIC INDICATORS

2.1 Evolution of the CFP in relation to environmental agendas

The integration of environmental requirements in the Common Fisheries Policy (CFP) is embedded in an incremental process that explains current state and issues. Current legal frameworks and policy objectives at international and European Union (EU) levels are reviewed in the INDECO paper on ‘the current management framework’ (Reyntjens & Brown, 2005a). For the specific requirements of this review, certain points will be underlined.

At the origin, the CFP was built upon the principle of the, so-called, rational fishery management. It has evolved progressively from a single stock management approach to a broader approach integrating stock interaction issues. Moreover the CFP shall contribute to the achievement of the environmental objectives set out in Article 174 of the European Community (EC) Treaty, without prejudice to its economic and social objectives, which are:

- Preserving, protecting and improving the quality of the environment;
- Protecting human health;
- Promoting prudent and rational utilisation of resources; and
- Promoting measures at international level to deal with regional and global environmental problems.

The establishment in 1998 of a focus group between the European Commission and the environmental non-governmental organisations (NGOs) nourished reflections and encouraged the Commission to better integrate environmental issues into the CFP (CEC, 2000). The Communication on fisheries management and nature conservation in the marine environment (CEC, 1999), that defines objectives and promotes specific actions, was a key step of this integration process promoted at the Cardiff European Council (15/16.06.1998), the Cologne Summit (3/4.06.99) and the Barcelona Convention (2002). This Communication was completed and supported by the conclusion of the European Council (25.04.2001) on the integration of environmental requirements and sustainable development in the CFP.

At the international level, the Reykjavik Conference in 2001 on Responsible Fisheries in Marine Ecosystems (Garcia and De Leiva Moreno, 2001) recognised the importance of environmental dimensions and promoted a double approach for their integration in to fisheries management: Fishing impacts on marine ecosystem and marine ecosystems impact on fisheries. In other words, this approach suggests to take in to account, both, fishing pressure issues and fisheries vulnerability issues.

Similarly, human variables determining fishing effort variations were progressively integrated in sustainable development indicators. Primarily limited to the integration of costs in bio-economic models, more economic and social variables were developed related first to fishing units then to management systems. In 1993, the European Commission's advisory Scientific, Technical and Economic Committee for Fisheries (STECF) officially integrated the economic dimension highlighting the need for standardised economic information such as follow-up indicators related to economic results and fish prices.

Since 2004 EU Member States have been required to transmit to the Commission a suite of fishery economic indicators. This requirement was preceded by numerous

initiatives to build a framework to develop follow-up indicators. For example, the Concerted Action on 'Economic Assessment of European Fisheries' searched for the feasibility of such system, in particular the selection of a few reference indicators for all fleet segments (Concerted Action, 2004).

The changes in the Commission's approach and EU fisheries policy are directly connected to global initiatives for sustainable development following the 1992 UN Conference on Environment and Development (Rio Conference). The major international organizations have since this conference initiated general or sector specific reflections to operationalise sustainability objectives, especially through the Agenda 21 Action Plan.

The need for a normative reference framework to follow up tendencies and changes appeared particularly clearly. Such a framework would have to include Charles's triangle components (Charles, 1992) that are:

- Biological conservation;
- Rationalisation /economic efficiency;
- Community well-being and equity.

Apart from these three 'classic' components, the action plan of the Agenda 21 also promotes a change in management systems in order to improve their efficiency. The triangle was thus widened to include an institutional component through the application of good governance. Sustainability indicators as conceived in the Agenda 21 and Rio Conference were thus to feed back on the key elements of a system and to measure progress towards sustainability in integrating ecological, economic and social aspects as well as institutional capabilities.

However there is a gap in the treatment given to the four components. Actions were primarily taken on resource conservation issues, privileging environmental aspects. Recently the integrated nature of sustainable development has been highlighted and, the need for sustainability to apply on social, economic and institutional components¹ pointed out. It should thus be noted that the maturity of ecological and socio-economic information systems are far from equal. The socio-economic information systems are still mostly operating at the experimental scale.

Several initiatives to better take into account socio-economic components of fisheries should be mentioned:

- The Food and Agriculture Organization of the United Nations (FAO) transposed sustainable development objectives in fisheries in the *Code of conduct for responsible fisheries* (FAO, 1995). FAO also developed a guide to elaborate indicators (FAO, 1999).
- The Organisation for Economic Co-operation and Development (OECD) in 2000 initiated a reflection to develop fishery sustainability indicators and to strengthen in particular studies on socio-economic indicators (OECD, 2000). This led to the publication of a methodological synthesis (OECD, 2002) and a review of indicators other than biological and ecological (OECD, 2003a).

¹ *Social and economic components*: living conditions, health conditions, security, work conditions, etc. *Institutional components*: management arrangements and decision-making systems including participation, transparency or access to information issues.

- The European Commission for the preparation of the CFP Reform ordered a discussion paper on the social impact evaluation of fishery management measures (Rey-Valette and Cunningham, 2003).

2.2 Socio-economic indicators on environmental impacts of fishing activities

The INDECO concerted action is among others about socio-economic indicators on environmental impacts of fishing activities. The first step is to define variables and to point out processes that should be taken into account in the social and ecological systems to describe such impacts. Impacts of fishing activities can relate to several categories:

- direct/indirect impacts,
- impacts on flora/on fauna,
- impacts that can be directly evaluated monetarily/externalities requiring specific valuations.

Reciprocally, fisheries (and territorial economy) also depend on the state of the natural environment. This can be called ‘environmental vulnerability’ of human activities. These two axes structure most reflections on impact of fisheries on ecosystems and consequences of resources degradation for human societies. Current research on sustainable development indicators focuses on how to take into account interacting processes and on indicators that can describe these processes. Depending on the reference framework, indicators are defined by field (social, economic, institutional) or by type (PSR or DPSIR²). The matrix proposed for INDECO is crossing types and field.

Table 1 PSR/DPSIR framework and related nature of indicators

Driving forces	Pressures	State	Impacts	Responses
Indicators related to process, behaviours and indicators measuring pressures		Follow-up indicators of ecosystem and socio-system states		Indicators feeding back on management measures and management capabilities

The classification by type is implicitly used by the OECD (2003a) that distinguishes between:

- Indicators of economic and social fishery sustainability;
- Socio-economic indicators of driving forces and pressures affecting fishery sustainability; and
- Socio-economic indicators of fishery system capabilities to respond.

Precise approaches supporting this functional classification are needed. Follow-up on state and impacts requires a classification of variables. These variables are directly linked to the chosen reference framework of socio-economic and ecological sustainability. Thus indicators may be related to the fishery sector or to territories at

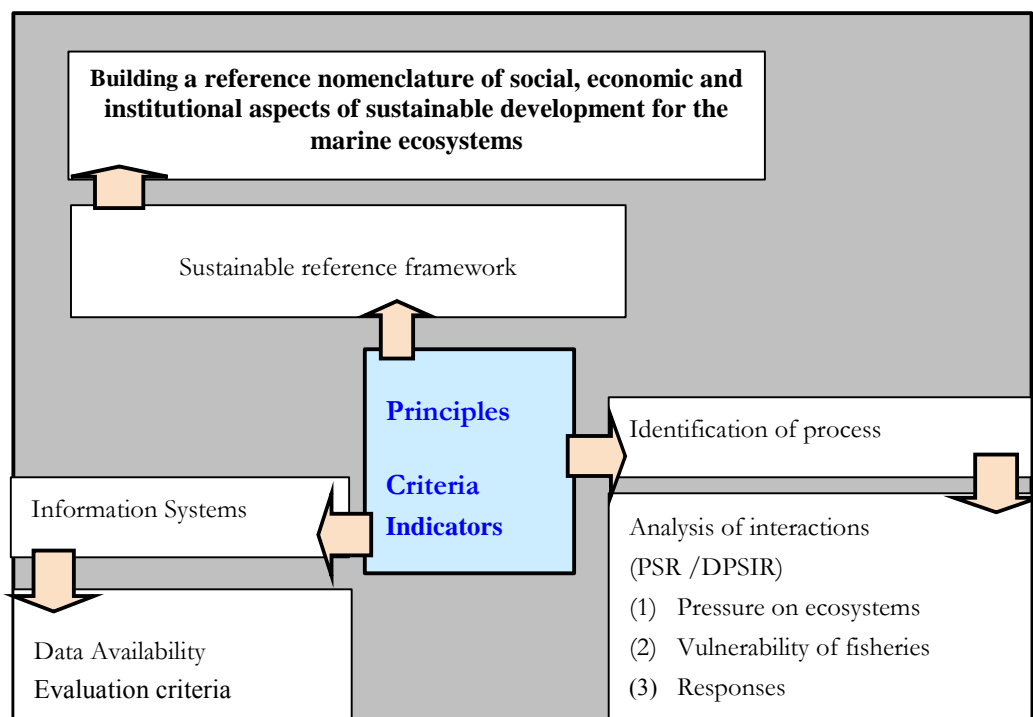
² PSR: Pressure-State-Response; DPSIR Driving forces-Pressures-State-Impact-Response.

various scales (local, regional or national). First, indicators of fishery socio-economic sustainability need to be developed. The elaboration of the second and third types of indicators (pressures and responses) requires an analysis of ongoing processes to identify the determinant variables for which indicators should be developed.

A common methodology to produce indicators is called ‘Principle-Criteria-Indicators’ (PCI). Indicators are meant to estimate criteria, which represent objectives associated with sustainability principles. Thus types of indicators and methodology to produce them can be linked (Figure 1):

- ‘Principle’ involves the representation of sustainability and the identification of stakes. It raises the issue of the elaboration process of indicators (especially difference between normative and procedural approaches);
- To set criteria structuring variables need to be identified. These variables may be identified at the term of the INDECO comparative study; and
- ‘Indicator’ is related to the information system and raises the issues of threshold, scales and valuation.

Figure 1 PCI Approach (Principle/Criteria/Indicators)



In the context of application of indicators in a management framework the International Council for the Exploration of the Sea (ICES) (2004) has been assessing several methods to classify the environmental management indicators, and to further develop the more precise definitions for the Pressure State Response (PSR), and the Driver, Pressure, State, Impact, Response (DPSIR) frameworks:

- *Drivers* – These are the forces which exert pressure on the ecosystem and its components. They may be anthropogenic or part of the natural environment.
- *Pressures* – These are the ways that the drivers are actually expressed, and the specific ways in which ecosystems and their components are perturbed.
- *State* – These are the properties of the ecosystem itself.

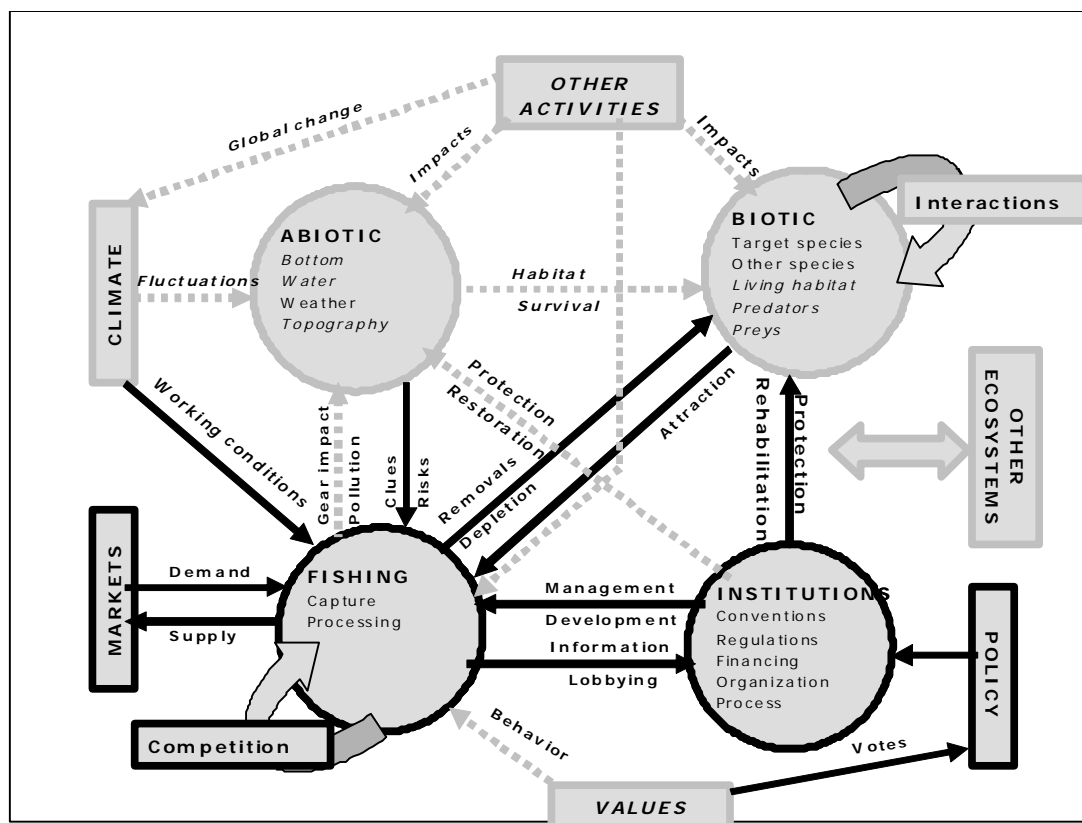
- *Impact* – These are the changes in State caused by the Pressures. This implies that there is a distinct and unambiguous relationship between the change in the state indicator and pressure.
- *Responses* – These are society's actions, taken in response to impacts judged to require remediation.

Sometimes, the PSR and DPSIR can appear confusing because the classification of at least some attributes in terms of Pressure, State, Impact or Response may depend on the context. For example (ICES 2004): to the fishery 'Catch' will be viewed as a State property, whereas to the species being exploited and the ecosystem, 'Catch' will be viewed as an impact; 'Days Fished' (ie Fishing Effort) can be an indicator of fishing Pressure but in the context of the effort control programme 'Days Fished' may also serve as an indicator for the Response to effort reduction.

Several frameworks to identify and classify interactions and processes impacting on sustainability have been developed, eg the framework of Garcia and Cochrane (2005) presented in Figure 2. This framework highlights the effects of other activities than fishing on marine ecosystem state. Treating this type of effects is beyond the INDECO work program that focuses on fisheries impacts. Only a few attempts to take into account these 'other effects' have been made in Integrated Coastal Zone Management (ICZM) and river basin research projects because of the high complexity of such systems.

Figure 2 Ecosystem components and interactions addressed by ecosystem approach to fisheries (EAF) (modified from Garcia et al., 2003).

(Elements in black and bold represents the conventional fishery management approach. Elements in grey and italics represents elements to add for EAF)



For INDECO, several preliminary components of these processes can be noted (Table 2).

Table 2 Socio-economic fishery system components: preliminary identification for INDECO

Driving forces and pressures	State and Impacts		Responses
Socio-economic analysis of fleets to characterise behavioural drivers.	Impacts of capture modification (species, fish size, etc...) on: (1) Prices and markets, (2) Revenue, (3) GDP, trade balance, employment.	Impacts evaluation: (1) Environmental externalities (biodiversity losses, impact on habitats) (2) Social and economic externalities (effect on cultural heritage, social cohesion, existence value, nutritional effects) (3) Induced or indirect economic effects on coastal economy (dynamics of activities linked to fishery, induced effects on tourism, effects on urbanisation and land value)	(1) Analyse of management systems (institutions, fishing effort measures) (2) Analyse of measures and decisions making arrangements (institutions, specific measures such as marine protected areas, no take zones, etc...) (3) Evaluation of management and communication capabilities (4) Follow-up institutional cost
Indicators related to fishing units and fleets	Indicators identified from macro-economic or fishery evaluation		Indicators identified from specific evaluations to measure non market value or macro regional indirect effects

2.3 The EU state of affairs

In the Communication on fisheries management and nature conservation in the marine environment (CEC, 1999), the European Commission identifies three levels of objectives:

- Identifying processes impacting on the structure, functioning, productivity and biodiversity of marine ecosystems;
- Considering interactions between components of the food chains;
- Protecting chemical, physical and biological environment necessary to marine ecosystems wealth.

To progress toward these objectives, the European Commission suggested a number of actions among which a few relate directly to the Common Fisheries Policy. These actions are the reduction of fishing pressure, the protection of environment, integrated coastal zone management, the reinforcement of formation, information and consultation, and the improvement of scientific research contribution. In fact, the integration of environmental protection into Community policies is as already mentioned an obligation under the Article 6 of the Treaty. Environmental integration into the CFP is based on the following guiding principles (CEC, 2002):

- (1) the CFP contributes to the achievement of the environmental objectives set out in Article 174 of the EC Treaty, without prejudice to its economic and social objectives;
- (2) the CFP is based on the principles of precaution, prevention, rectification at source and the polluter pays;
- (3) the CFP aims at a progressive implementation of an ecosystem-based approach, to the extent permitted by scientific knowledge.

In recent communications, the European Commission has proposed action plans to move towards better fishery management systems and practices ensuring environmental protection. These include the Biodiversity Action Plan for Fisheries (BAP) and the Communication setting out a Community action plan to integrate environmental protection requirements into the Common Fisheries Policy (CEC, 2001a; CEC, 2002).

The overall objective of the fisheries BAP is to define and identify, within the current legislative framework, coherent measures that lead to the preservation or rehabilitation of biodiversity where it is perceived as being under threat due to fishing or aquaculture activities. Key areas of action are:

- promote the conservation and sustainable use of fish stocks and feeding grounds through control of exploitation rates and through the establishment of technical conservation measures to support the conservation and sustainable use of fish stocks (eg closed areas and mesh size regulations); and
- reduce the impact of fishing activities and other human activities on non-target species and on marine and coastal ecosystems to achieve sustainable exploitation of marine and coastal biodiversity.

The action plan to integrate environmental requirements into the CFP complements the BAP for fisheries in stating objectives and guiding principles and in setting priority measures which are:

- reduction of fishing pressure to sustainable levels;
- improvement of fishing methods with a view to reducing discards, incidental bycatch and impact on habitats; and

- elimination of public aid for the modernisation or renewal of the fishing fleet except for aid to improve safety and/or product quality without increasing the fishing capacity.

For the evaluation and monitoring of fisheries management environmental performance, it is suggested to develop a comprehensive monitoring system including benchmark and indicators of driving forces, pressure, state, impact and response (DPSIR). The proposed priority measures are based on a first analysis of the driving forces, pressure and state of EU fisheries and management systems that is largely based on the appraisal made for the Green Paper on the future of the Common Fishery Policy (CEC, 2001b).

The Green Paper noted that the fisheries sector is characterised by economic fragility resulting from over investments, rapidly rising costs and a shrinking resource base. This is reflected in poor profitability and steadily declining employment. To explain the situation, the Commission identified a number of issues and in particular that:

- the sustainability of a high number of fish stocks will be threatened if the current levels of exploitation are maintained. The risk is highest for demersal round fish stocks;
- effort management has yielded poor results;
- there are difficulties in controlling exploitation rates due to i) the EU Council systematically fixing some total allowable catches (TACs) at levels higher than proposed by the Commission on the basis of scientific advice and ii) over-fishing, discards and fleet over-capacity;
- technical measures are not always adapted (eg. mesh sizes are too large). Compliance with technical measures remains problematic. The use of selective fishing techniques is far from having achieved its potential;
- enforcement faces difficulties; and
- there are weaknesses in scientific advice and information.

In details, the Commission identified a number of issues related to policies and objectives: conservation policy, environmental dimension, fleet policy, decision-making process, monitoring and control, economic and social dimension (Annex 1). Weaknesses identified in the fishery management system, in general, have a direct or indirect link with fishing impacts on the environment. It is therefore necessary to propose a framework capable to embrace driving forces, pressures, and responses that impact on the state of the fishery including the environmental state.

3 THE STATE-OF-THE ART: REFERENCE FRAMEWORKS AND IMPLEMENTATION OF SOCIO-ECONOMIC INDICATORS

3.1 Reference Frameworks for fisheries

3.1.1 FAO

The FAO has proposed a reference framework for the elaboration of sustainability indicators: the sustainable development reference system (SDRS) (FAO, 1999). This framework integrates the four dimensions of sustainability, ecosystem, economy, community and governance (See Annex 2). FAO proposes a methodology to define indicators on the basis of a small number of key criteria or variables. Then, dependant on the purpose, appropriate indicators and related reference points (=threshold value)

are defined. The objective is to have a system of references that facilitates follow-up of progress toward sustainable development in order to identify issues and to evaluate efficiency of management measures

In this approach, indicators are also considered as being part of an information system. This means that the building process of an indicator has to take into account the modality of information organisation and the result format for dissemination. This requires specific work on data aggregation or representation and on restitution of knowledge. On this specific aspect the kite diagrams proposed by Garcia and Staples (2000) follows in the tradition of previous similar work such as the sustainability barometers (Prescott-Allen, 1997) and the vulnerability indices of insular developing economies (Briguglio, 1997).

3.1.2 OECD

Compared to others, the specificity of the OECD contribution is the pointing out of the need for integrating social and economic components in the analysis (OECD, 2000, 2002 and 2003a). The OECD also highlights difficulties of a such integration because of the qualitative nature of criteria and the lack of available information. Several types of indicators are identified (sector, resource, result, synthetic) arranged in a type of pyramid depending on data aggregation and also on the needs and demands.

The 2002 OECD report summarises methodologies for indicator elaboration and selection. There are two main types of frameworks that link objectives, indicators and results. The accounting framework aims at integrating environmental aspects into public accounting, in physical and monetary units. An example of this is the accounting of fishery resources in Australia. The other analytical framework allows a functional classification of relationships where the choice of indicators is related to the analysis of interactions between causes, effect and actions. The most common analytic frameworks to identify such relationships are the Pressure-State-Response (PSR) and the Driving forces-Pressure-State-Impact-Responses (DPSIR) frameworks.

These frameworks were used in an early stage to take into account environmental aspects in public policy development and not specifically for the socio-economic aspects. In fact, some researchers advocate that they are not well adapted to identify the dynamics of the socio-economic components (Theys, 2002).

In addition to these two types of frameworks, the OECD proposes indicators, called 'resources-results', to evaluate the preservation of environmental, economic and social assets (OECD, 2002). A few pilot initiatives based on these indicators are mentioned, especially in Canada. Apart from the analysis of frameworks and indicators cited above, examples given in the report refers largely to the FAO sustainable development reference system. A review of indicator uses at country level completes the OECD analysis. It highlights the diversity of approaches, especially in terms of logic and scale. Two entries dominate: territorial impact of fisheries management and economic performance of fishing fleets. The 2002 report was updated and completed in 2003 (OECD, 2003a); it contains a methodological analysis and a detailed review of indicator uses at country level. Moreover, the report underlines the role of indicators as support for communication on fisheries

sustainability. The most advanced experimentation occurs in Australia³ and Spain for which a specific OECD report has been produced (OECD, 2001).

3.1.3 Australia

The Australian ESD framework is slightly shifted compared to international frameworks because it is one of the first to be implemented and adapted to the local context and also used to develop the FAO framework further.

The term Ecologically Sustainable Development (ESD) was adopted in Australia to emphasise the importance of the environment to long-term survival and to ensure that there was a balanced approach in dealing with environmental, social and economic issues. The Australian National Strategy on ESD includes three key objectives:

- to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations;
- to provide for equity within and between generations; and
- to protect biological diversity and maintain essential ecological processes and life-support systems.

Each management unit has to report on ESD progress. The management unit is the fisheries as defined by management agencies. The ESD framework, presented in the form of trees, is divided in three categories and eight components (Fletcher et al., 2002):

- *Contribution of the fishery to ecological well-being*: (1) Retained species (2) Non-retained species (3) General ecosystem;
- *Contribution of the fishery to human well-being*: (4) Indigenous well-being (5) Local and regional well-being (6) National social and economic well-being; and
- *Ability to achieve*: (7) Governance (8) Impact of the environment on the fishery.

Each tree is adapted to the specific context of a fishery in order to define criteria and indicators to follow up progress toward ESD objectives.

3.1.4 ICES

The ICES indicator framework for fisheries management advice is in transition from the precautionary approach framework which was implemented from the second half of the 1990s to a framework which also considers societal benefits. The precautionary approach framework was based on the notion that advice from natural sciences should only relate to risks to biological sustainability. The central indicator was the state of the stock relative to the biomass of parent stock below which there was risk of impaired reproduction (B_{lim}). Given the uncertainty of stock assessments the risk averse approach was to evaluate whether the parent stock was above a safe level (B_{pa}) which was identified such that if the estimate of parent stock size was above B_{pa} then there was low risk that the real stock size was actually below B_{lim} . The fishing mortality which in equilibrium would maintain the stock at B_{pa} was used as an indicator of maximum sustainable exploitation termed F_{pa} . The stocks were thus

³ It should be noted that the FAO reference framework (FAO, 1999) has been inspired by the experimentation made in Australia.

termed ‘outside safe biological limits’ if the parent stock was below B_{pa} and/or the stocks were fished with an exploitation rate above F_{pa} .

According to ICES (2005) when implementing an ecosystem approach to fisheries management, indicators are required (1) to describe the pressures affecting the ecosystem, the state of the ecosystem and the response of managers, (2) to support management decision making, (3) to track progress towards meeting management objectives and (4) to communicate the effects of complex impacts and management processes to a non specialist audience.

The advice based on this framework only related to biological sustainability and left it to policy decision makers to deal with societal benefits. In practice, management decisions were taken which used the risk aversion reference points as targets rather than limits and as a consequence most stocks were exploited at or above F_{pa} and the parent stocks were maintained at or below B_{pa} . From a societal perspective this was suboptimal since F_{pa} for the majority of stocks is well above the exploitation rate which will ensure maximum yield - exploiting stocks around F_{pa} implies overcapacity and lower yields than could have been produced otherwise.

This has also been realised by the clients for ICES advice on fisheries management. ICES is now, in response to requests from clients, developing a framework for advice which is based on long term management plans that combines aversion of risk to stock reproduction within the precautionary approach with societal objectives as formulated by managers. These are high long term yields and certain management performance criteria such as bounds on the inter-annual variation in fishing opportunities. Advice within this framework will still aim at maintaining low risk to reproduction but identifies target fishing mortalities, which within the management plan framework will also produce high long term yield.

More strategically, ICES is working on a comprehensive systems approach to fisheries management which includes a wider understanding of institutional and economic dynamics. The ICES strategy identifies the need to ‘Evaluate the potential of new management regimes and strategies that are robust, cost effective, and sustainable’ and the need to ‘Develop and improve fisheries assessment tools that utilize environmental information, consider biological and socio-economic interactions, and address issues of uncertainty, risk, and sustainability’.

This systems approach integrates issues of uncertainty, risk and durability to analyse performance of fishery systems (ICES, 2001, 2002). It has been developed as an extension of the framework established by the International Whaling Commission and identifies the following: system of knowledge acquisition, decision-making system (public policy), implementation and adaptation system (fleet adaptation to measures). The ICES approach aims to be both rigorous and flexible. The framework has been developed and applied to case studies, notably North Sea cod through an ongoing European research project on ‘Policy and knowledge in fisheries management’. For further details of the new ICES approach please refer to Annex 4).

3.2 National and international reference frameworks for sustainable development

In practice, experimentation at national and international levels often differs from the initial PSR or DPSIR approaches. For example, in France, a specific reference framework has been produced that articulate external and internal aspects impacting on sustainability (IFEN, 2001). Nine components were identified:

- Efficiency of productive system (inputs, structure, productive system, pressure and impact);
- Capture and critical pollution (extraction of resources, pollution and discards),
- Patrimonial management (natural, human and institutional heritage, heritage represented by built environment);
- Repartition and spatial inequity (carrying capacity, density issues, polarisation and spatial inequity, access to services, webs, mobility, spatial inequity reduction policy, consumption of fragile space);
- Globalisation and governance (pressure on resources and on natural environment of the rest of the world, economic, social and institutional relationships with the rest of the world);
- Access to revenue, services and heritage: inequity and exclusions (ecological inequity and risk exposure, access inequity to services and goods, inequity of revenue and exclusion);
- Satisfaction, preferences, engagement, politics and governance (preferences and declared dissatisfactions, behaviour of oppositions and disengagement, engagement and participation in civil society, governance, institutions and public participation);
- Accountability and precautionary principle (institutions, taking into account sustainable development, negative links to future generations, prevention, precaution); and
- Resilience, adaptability, flexibility, development of reactivity (vulnerability and environmental dependence, socio-economic and technical adaptability and flexibility, risk management and crisis).

Since March 2005, EuroStat has been publishing a panel of sustainable development indicators for EU countries. This panel is based on the EU strategy and priorities adopted at the Gothenburg (2001) and Barcelona (2002) Summits. The 120 indicators are classified in 10 categories:

- Economic development (gross domestic product (GDP)/person);
- Poverty and social exclusion (rate of poverty risk);
- Society ageing (ratio of aged people dependence);
- Health (life expectancy in good health at birth per sex);
- Climatic change and energy (emissions of green house gases, national energy consumption);
- Models of production and consumption (national consumption of raw material);
- Natural resources (changes in bird populations in cultivated areas, capture of fish outside safe biological limits);
- Transportation (total energy consumption for transportation);
- Good governance (Public opinion confidence in European Council, European Parliament and the European Commission); and
- Partnerships (public funds for development).

The choice of scale partly depends on the approaches chosen. Two main types coexists: a functional approach centred on fisheries and a territorial approach often centred on regional economy. A national scale may also be chosen to integrate the macro-economic dimension of impacts on trade balance, GDP, employment, etc. The national scale is also the most operational to compare sectors. However, taking into account territorial aspects raises the issue of physical delimitation of the management unit. It also introduces the question of imported and exported sustainability linked with spatial interdependencies (Pearce et al., 1989). Imported sustainability relates to territorial sustainability obtained with negative or positive externalities outside the territory (eg pollution or inputs of natural resource). Effective sustainability is the result of a balance between internal and external sustainability. Otherwise the territorial sustainability is achieved at the detriment of other territories, which leads back to the concept of 'territorial sacrifice' (Nijkamp et al., 1992, cited by Laganier et al., 2002).

3.3 Process Indicators (vulnerability, pressure, response)

3.3.1 State

The OECD Review (2003a) presents a comprehensive analysis of national fishery management systems and uses of indicators in Australia, Denmark, Italy, Japan, Korea, Spain and USA. It underlines for each country the purposes, concepts, framework and data availability for the development and use of indicators. It insists on the need for indicators that are understandable to managers. Countries consider economic and social sustainability in various ways but mostly through the evaluation of:

- management system performance;
- ex post management decision;
- progress toward sustainability; and
- fishery impacts.

The review shows the diversity of approaches but also the weakness in terms of operational and regular implementation. In most countries, follow-up is centred on fishing effort. Data availability issues often explain the gaps in the set of socio-economic indicators. Certain data related to economic results are difficult to obtain because of their confidentiality or, especially for artisanal fisheries, because of the lack of primary information and the multi activity of units (informal activity). Thus the report points out the specific case of subsistence fishery or leisure fisheries. The complexity of processes, the qualitative or non-market nature of certain effects are also a constraint to the development of indicators. Thus the Japanese and United States reviews point out difficulties to evaluate the cultural or nutritional value of fisheries. The Japan case illustrates importance and difficulties to evaluate the dependence of coastal regions on fisheries activities (concept of community living on natural resources⁴). This implies to take into account and 'evaluate' both economic effects and specific life style supported by fishing communities values. The data availability issue may also be related to the lack of legitimate structures for gathering the information or the lack of a structured framework like eg in Korea.

⁴ Defined as a population living in a delimited area which cultural life style is supported by the exploitation of renewable natural resource (OECD 2003a).

Representativity may also be an issue as economic studies are specific to a fishery or an area. Systematic approaches at a larger scale are missing. Finally, it is noticeable that most indicators relate to *ex post* evaluation when *ante* reference are needed to intervene earlier and adjust policies.

The OECD review highlights the limited number of used indicators, mostly centred on fishing effort. The best examples are in Korea. Here indicators are defined as estimations derived from bio-economic models based on maximum sustainable yield which integrates data on cost, revenue, capture and effort. Spain, with the case of the Alboran sea, proposes the largest panel of indicators (around 15) classified in the following matrix (Table 3).

Table 3 Matrix of indicators for the Alboran Sea, Spain

Indicators of production	Indicators of economic productivity	Social Indicators	Indicators of capital and benefice
- Average production per boat and per port	- Production value per management unit - Production value per capacity unit - Production value/power	- Value in the first hand trade/ fisherman - Salary	- Gross results of the exploitation per fleet and per port - Net results of the exploitation per fleet and per port

From OECD, 2001

The most frequent scale used in local analysis is the fishery. The diversity of stakes and reference frameworks complicates the definition of common indicators for international comparison. The review points out that no country is using the Pressure/State/Response framework. Australia is the most advanced country in routine uses of indicators, in particular it has developed a national system for the definition of indicators that is applied to all fisheries.

3.3.2 Appraisal

The OECD (2003b) analysis proposed a sum table of the themes to measure progress toward sustainability objectives: price, economic results, public financial transfer, management cost, social cost, etc. Two types of approaches arise:

- Approaches centred on the evaluation of modification of fisheries management policies at regional scale (US, Japan) with a territorial focus (area or community dependent on fisheries);
- Approaches centred on economic results of main fleets (Spain, Italy, Korea, Australia) with a sector focus.

These two approaches do not reflect the two axes of the general framework: fisheries impacts on environment in a PSR logic and consequences of environmental changes on fisheries in an activity vulnerability to natural environment logic. The Millennium Ecosystem Assessment Synthesis Report (2005) and the seminar on Quantitative Ecosystem Indicators for fisheries management (2004) highlight that researchers mainly target the development of indicators to follow up impacts on the environment (in other words ecosystem's state and vulnerability to fishing pressure). Integrated approaches of interactions are still underdeveloped.

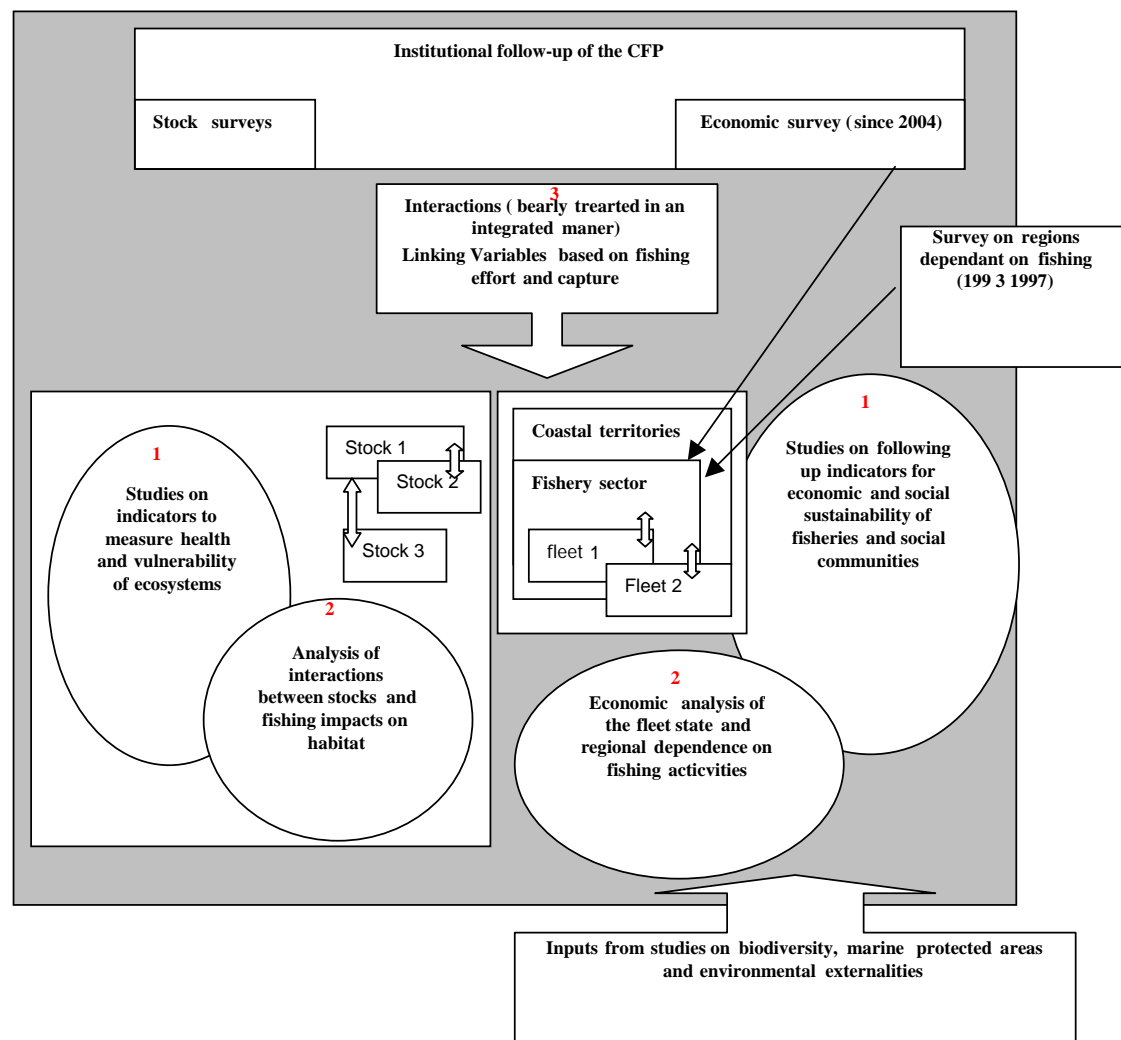
Apart from fishing effort, very few studies analyse driving forces and pressures. Garcia and Cochrane (2005) insist on the need to fully consider that fishers, and

society, are fully part of the ecosystem. This postulate was already underlined at the Reykjavik Conference (2001). As mentioned above, the two authors propose a scheme summarising these interactions (Figure 2).

Research undertaken for other purposes can also be used. In the development of integrated coastal management approaches, typologies of impacts are proposed to characterise pressures (direct or indirect, related to resource, capture, space and consumption...) (Rey-Valette, 2005). Economic valuation of externalities and measure of values related to services provided by the natural environment are other useful sources and so is the abundant literature on marine protected areas and biodiversity valuation.

Having attempted to reconstitute the methodological path of research on indicators, depending on need and types of indicators, Figure 3 is obtained.

Figure 3 Elaboration framework of fishery sustainability indicators in the European Union



3.4 Thematic Indicators

3.4.1 Economic indicators

A recent FAO report (FAO, 2004) specifies key indicators and sets guidelines for the identification of demographic issues in coastal area management, the collection of data, and monitoring of the impact of management measures on the socio-economic well-being of coastal and fishing communities. Case studies on the use of demographic data in coastal area management in Italy and the United States, and a summary of the proceedings of a regional workshop on the use of demographic data in coastal area management in the Philippines and other Southeast and South Asian countries provide practical examples of how demographic indicators are used.

Standardised indicators and protocols of indicators development were also developed within the framework of the Concerted Action 'Economic Assessment of European Fisheries' comprising the twenty EU countries with coastlines (Concerted Action, 2004). The segmentation, based on the European Commission criteria, represents 60-70% of the value and volume of landing (6,6 billion Euros) and over 40% of employment (210 000 people). Each year, a presentation of the sector was presented based on the following indicators (Table 4).

Table 4 Standardised Economic Indicators developed in the Concerted Action on 'Economic Assessment of European Fisheries'

Scale	Indicators
Country level	<p><u>Synthesis indicators</u>: value of landings, employment on board, volume of landing, number of vessels, total kw, gross value added, Gross cash flow, net profit, invested capital, total GT, evolution compared to last years (value of landing, GVA, GCF),</p> <p><u>Economic performance</u>: short term evolution (number of segments and economic size of fleet according to their performance %)</p> <p><u>Detailed indicators</u>: effort (days at sea), fuel costs, other running costs, vessel costs, crew share, depreciation, investments, composition of landing (major species value and volume), composition of fleet (by size (<12, 12-<24, 24-<40, >40 m) and age)</p>
Region level (North Sea, Baltic Sea, North Atlantic, Central Atlantic, South Atlantic, Mediterranean Sea, Others)	<p><u>Synthesis indicators</u>: number of segments, value of landings, gross value added, employment, volume of landings, number of vessels, total kw, value of landings/man, GVA/man, KW/vessel, value/vessel, value/kw, value/tonne</p> <p><u>Evolution</u>: employment, number of vessels, value, volume,</p> <p><u>Economic performance</u>: comparison between fleet segments : GVA as % of value of landing, GVA /employed, GVA/KW</p>
Individual Segment	<p><u>Economic performance</u>: short and medium term evolution, GVA/value of landings, GVA/crewman and value of landings/kw</p> <p><u>Synthesis indicators</u>: Value of landing, Gross value added, Gross</p>

Scale	Indicators
	<p>cash flow, net profit, employment on board, Invested capital, number of vessels, total GT, total kw, economic performance, evolution compared to last years (value of landing, GVA, GCF),</p> <p><u>Detailed indicators:</u> effort (days at sea) fuel costs, other running costs, vessel costs, crew share, depreciation, investments, composition of landing (major species value and volume), composition of fleet (by size (<12, 12-<24, 24-<40, >40 m) and age)</p>

Source: Concerted Action, 2004.

This Concerted Action aimed at providing reference data to the STECF according to the 'basic' CFP regulation (2371/2002 of 20 December 2002, article 33) and to contribute to the inclusion of economic considerations. It also aimed at preparing member states to comply with their obligation to transmit economic data to the EU after 2004. Facing this requirement, most European countries have established regional monitoring of national fleets. In France, Ifremer has initiated a program called 'Fishery Information Systems' in which socio-economic surveys are realised (~700 fishing units surveys at national scale). Syntheses were produced for the North Sea, the Channel and the Atlantic Ocean for the years 2001 and 2002 and for the Mediterranean Sea for the year 2001. Results are aggregated per region or fleet. These syntheses contain the indicators required for the EU completed with more specific data on multi-activity, user conflicts, etc.

At European level some other initiatives should also be noted. A recent initiative was the 'Regional socio-economic studies on employment and the levels of dependency on fishing'⁵, which was supported by the European Commission and implemented in all member states - fifteen at the time - by consultants and research institutions in 1999. The aims of the study were to:

- quantify and describe the socio-economic importance of fishing and aquaculture in Europe;
- determine the level of dependency on fisheries of these areas, in terms of jobs and incomes;
- examine the trends in evolution of employment since the 1991 socio-economic studies; and
- examine the extent to which the socio-economic measures currently in place have been implemented, and the potential in the coastal areas for conversion and diversification of employment.⁶

To establish the level of dependency (second aim) three indicators were used:

- 1) the share of the fisheries in the value added in the area;
- 2) the share of fisheries in total regional employment; and

⁵ MegaPesca website: <http://www.megapesca.com/fishdep/eufishindex.htm> (accessed 20 May 2005).

⁶ MegaPesca website: <http://www.megapesca.com/fishdep/About.html> (accessed 19 May 2005).

3) the share of catches subject to CFP quota management measures as a proportion of total catches.

A number of other economic indicators for the fisheries sector were also gathered in the study, which examined 22 individual fisheries regions. The units studied in these regions ranged from NUTS2 to NUTS5.⁷ The outcome of the project was a comprehensive collection of data and indicators for fisheries in general and fisheries in the most fishing dependent regions of Europe including regional fisheries profiles as of 1996/1997. The data obtained constituted important background material for the EU Commission's Green Paper on the Common Fisheries Policy from 2001.

Another recent, ongoing initiative is the Commission sponsored European Spatial Planning Observation Network (ESPON) programme⁸, which looks into regional development trends through the means of a considerable number of coordinated projects on various themes and policy areas etc. The aim of the programme is to provide:

- a diagnosis of the principal territorial trends at EU scale as well as the difficulties and potentialities within the European territory as a whole;
- a cartographic picture of the major territorial disparities and of their respective intensity;
- a number of territorial indicators and typologies assisting a setting of European priorities for a balanced and polycentric enlarged European territory;
- some integrated tools and appropriate instruments (databases, indicators, methodologies for territorial impact analysis and systematic spatial analyses) to improve the spatial co-ordination of sector policies.⁹

One of the projects - ESPON project 2.1.5: Territorial Impacts of European Fisheries Policy - relates to the regional impact of the Common Fisheries Policy. The project is to a large extent focussed on collecting and presenting indicators, which can assist in determining and understanding specifically the regional impact of (changes in) the Common Fisheries Policy and recent years developments in the coastal regions throughout Europe. The project aims at answering among others the following questions:

- How will these changes and ongoing processes affect European countries and their regions? What are the territorial impacts on Europe of the changes in view of the aim of cohesion, territorial balanced and sustainable development and polycentrism?
- What are the potentials and the preconditions for innovations in the marine sector? How would new economic dynamics influence the diversity of types of coastal regions?

⁷ NUTS refers to the 'Nomenclature of territorial units for statistics', which provides a uniform breakdown of territorial units for the production of regional statistics for the member states of the EU and a few other European countries. NUTS2 regions range ideally from a minimum of 800,000 inhabitants and to a maximum of 3 million. NUTS5 is now known as Local Administrative Unit (LAU) level 2. LAU level 2 corresponds generally to municipalities. See Eurostat website: http://europa.eu.int/comm/eurostat/ramon/nuts/splash_regions.html (accessed 20 May 2005).

⁸ ESPON website: www.espon.lu (accessed 20 May 2005).

⁹ ESPON website: <http://www.espon.lu/online/documentation/objective/index.html> (accessed 20 May 2005).

- How will effects of fisheries policies influence spatial development in coastal regions, a polycentric development at local/regional level? What role does accessibility play for developing new activities in the fishing industry in different regions?
- What are the impacts of fisheries policies to be taken into account in different types of coastal regions in relation to the concept of Integrated Coastal Zone Management (ICZM) as defined by the EU members States?¹⁰

For the purpose of answering these questions the project, which involves partners from a number of EU countries, as well as Norway and Iceland, compiles relevant available territorial data/indicators from various sources. The sources of the key indicators include FAO, Eurostat, OECD, other ESPON projects and national statistical bureaus etc. The ESPON project differs in this way from the regional dependency-study mentioned above, which compiled primary data and created indicators based on these data. The ESPON study to some extent draws on the data and experiences of the regional dependency-study. The project is divided in several parts; two of the main parts deal with social cohesion and economic cohesion respectively.

The ultimately aim of the study (in relation to indicators) is to present fisheries data - with data-sources so that updates can be made - for each coastal NUTS3¹¹ region in EU25+2 and Norway and Iceland. A major difficulty faced by the project, which runs from 2004 to 2006, has until now been accessibility to data on lower levels than national. The data and indicators compiled by the project will eventually be available together with indicators gathered by the other ESPON projects. This is expected to assist the setting of priorities for the creation of a balanced and polycentric Europe. It is not yet possible to know how the fisheries data and indicators will be used since the overall ESPON project is still ongoing and the fisheries project less than halfway.

At supra European level, the economic group of the General Fisheries Commission for the Mediterranean (GFCM) for the Mediterranean Sea is attempting to harmonise economic data. Spain and Italy have developed two research projects supported by the FAO: AdriaMed and Copemed to support data harmonisation and build a Mediterranean data base.

An AdriaMed Working Group on Operational Units in the Adriatic Sea was organized in Durrës, Albania, April 2004. The meeting focused on the development of the Operational Unit concept, identification of pilot studies programme. To compile the standard Operational Unit table, data are generally reported in total for the given group of vessels. The average value can be considered instead for vessel value (8) and fishing hours per day (10). For some parameters an estimation method is suggested:

- (1) *Vessel N.* = Number of fishing vessels belonging to the given Operational Unit.

¹⁰ ESPON website:

http://www.espon.lu/online/documentation/projects/policy_impact/policy_impact_144.html (accessed 19 May 2005).

¹¹ NUTS3 regions have ideally a minimum of 150,000 inhabitants and a maximum of 800,000. See Eurostat website: http://europa.eu.int/comm/eurostat/ramon/nuts/splash_regions.html (accessed 20 May 2005).

- (2) *Gross Tonnage* = Total gross tonnage of fishing vessels belonging to the given Operational Unit.
- (3) *Horse Power* = Total engine power of fishing vessels belonging to the given Operational Unit.
- (4) *Employment* = Total number of people employed on fishing vessels belonging to the given Operational Unit. The number of crew members can be estimated on a full time equivalent (FTE) basis.
- (5) *Salary Share %* = Percentage of the revenues after discounting commercial costs, daily costs and fuel costs that pertain to the crew. It will be distributed among the crew as salary.
- (6) *Landing weight* = Total landings in weight.
- (7) *Landing value* = The volume of landed fish valued against actual market prices. It equals to quantities landed (6) multiplied by the landing average price.
- (8) *Vessel value* = This is defined as total invested capital – value of hull, engine, gear and equipment. The replacement-value method can be used to estimate this parameter.
- (9) *Fishing days/year* = Number of fishing days per year.
- (10) *Fishing hours/day* = Number of fishing hours per day.
- (11) *Cost of fishing/day* = This includes daily expenses incurred in fishing activity, such as fuel, lubricants, etc. They are variable costs which depend on the time spent to fish.
- (12) *Yearly Fixed costs* = This comprises costs not directly connected with operational activity, such as non-routine maintenance, vessel insurance, taxes and dues, etc. The fixed costs are all the costs that are inevitable to pay yearly, independently from the time spent to fish.

The working group meeting on socio-economic indicators held in Barcelona (March 2004) worked on a survey in North African Countries (Tunisia, Algeria, Morocco) based on a reference framework established within Copemed. Results published by FAO present a suite of socio-economic indicators, a segmentation methodology per fleet and areas, a field survey methodology and the state of fisheries in Algeria, Spain, Morocco and Tunisia. Similarly to the Economic Assessment of European Fisheries Concerted Action, the working group produces an annual report with country reviews. A manual on statistical sampling methodology for socio-economic indicators on Mediterranean fishing fleets was also elaborated by GEM (Spain) and IREPA (Italy) and published by the FAO (Franquesa, R.; Malouli, I. M.; Alarcón, J.A., 2001).

The fifth economic and social sciences (SCESS) Sub-Committee Meeting was held in Malaga, May 2004, with ten countries represented (Albania, Algeria, Italy, Lebanon, Libya, Morocco, Spain, Syria, Tunisia). The Committee worked on the definition of operational units, on the result format for indicators developed in Algeria and Tunisia and on final report format. Three specific studies that reinforced knowledge on socio-economic factors were presented:

- Adriatic Sea Fish markets realised by Adriamed,

- Adriamed sociological survey of Albanian marine fisheries (Questionnaire structure),
- Proceedings of workshops on fisheries regulation in Copemed countries initiated in 2001 (Algeria, France, Italy, Libya, Malta, Morocco, Spain, Tunisia).

3.4.2 *Social Indicators*¹²

Social aspects have gained more importance, especially through the concepts of social capital and governance. The challenge is to identify conditions for the long term viability of societies. Two dimensions of social impacts can be identified:

- The impact of management measures on the social community. This may be shown by ‘the evolution of property rights, living conditions, and inequalities’ (OECD, 1997).
- And also the influence of social conditions on the efficacy of policies. This relates to ‘family relations, work satisfaction, training, age distribution, local conditions, ethnic and cultural differences and social cohesion’ (OECD, 1997).

Analyses of the impact of fishery management generally concern one measure (especially individual transferable quotas (ITQs)) and usually a particular fishery. Two OECD studies, both recent and of general interest, may be taken as reference points: one on sustainable fisheries (OECD, 1997) and the other on social indicators of sustainable development (OECD, 2002). In the case of fishing, the problem of social impact has so far been dealt with in a very narrow sense, concentrating on a limited number of indicators, especially employment and wealth and income distribution, and limited to fishing units (usually just the owners). The aspects covered are the impact on income and wealth distribution, the number and nature of jobs, the cohesiveness of rural communities, security and working conditions (often related to trip length); conflicts and gear loss. This review notes important progress on the social aspects of sustainable development at the level of ‘income distribution, household consumption and employment’ and suggests that the measurement of social capital is among work in progress. It is necessary to extend the scale of the analysis of social effects in fishing. Depending on needs, these analyses could be undertaken at the level of the fishing unit, family unit (households), community, the fisheries sector, the regional or even the national economy. It is also necessary to extend the range of indicators taken into account. Some work is presented here but it requires strengthening. At the moment, there is much more work and there are many more indicators concerning the management (the resource) than there are of the aims of management which ultimately is social welfare.

One of the objectives of social impact analysis is to identify inequalities and different impacts on disadvantaged sub-groups. This may be a function of age, of gender especially for the question of recognition of work or a function of particular fishing categories, eg small-scale fisheries.

Looking at scales and the nature of effects leads one to the analytical framework in Table 5 which develops the elements discussed above, and presents them as a function of the observation level.

¹² This section has been written from the paper written by Rey-Valette and Cunningham (2003) on social impacts of fishing management measures. This paper was presented for discussion at the European workshop organised by the EU Commission on ‘The Introduction of Right-based Management in Fisheries’. Brussels, 3-4 April 2003.

Table 5 Scales of social effects

Scale	Nature of elements to monitor
Fishing unit	Income, Employment, Safety on-board, Crew working conditions, Social security of crew, Training, Share systems, Regularity of employment
Family unit (household)	Reconciliation of family and professional life (working hours, bank holidays etc.), Income variability and vulnerability, Social security and living conditions (insurance, health), Ability to sell assets at end of career, Recognition of women's work and social protection
Community	Organisation of fisher groups and community social capital, Employment, Social status of job, Effects of exclusion. Ease of installation for the young, Conflicts between métiers, Discrimination in resource access, Discrimination in access to credit and information, Inequalities within the community, Recognition of women's work, Recognition of disadvantaged groups (small-scale fishers...)...
Industry; and policy implementation	Community social capital, Mode of participation and consultation of stakeholders, Transparency in decision-making, Ease and cost of control, Institutional strengthening...
Regional economy	Employment, Income, Cultural role of fishing, Cultural capital as a local economy development resource, Impact of concentration and spatial polarisation

Source: Rey-Valette and Cunningham, 2003.

There is a need also to be aware of critical mass problems. A limit may be reached below which the activity is no longer viable in particular places. A new restructuring plan, or even a temporary halt, may lead to the total disappearance of the sector. Similar problems may affect upstream (shipyards) and downstream (processing and marketing) activities. If too few fishers are left in certain places, all sector activities may relocate to other ports, reinforcing the initial reduction. In the end, a failure to consider critical mass effect could lead to a polarised sector based on fewer and fewer ports.

Inequalities may also arise from the way in which fishers are organised and their relative power locally, especially where structural support is offered, which require good organisation of the fishers and reasonable institutional knowledge. Territorial differences may lead to different levels of support in better organised places or where fishers are better represented. Small-scale fishers may lose out in such a process, especially because they are often less well represented and their true economic value tends to be under-estimated.

Table 6 Institutional capacity as a function of territorial types

	Fishery dependent zones	Fishery non-dependent zones

Rural coastal zones Characterised by weakness in other activities (declining zones)	Fishing not necessarily very important in absolute sense but important motor because of absence of alternatives.	Fishing marginal and at risk of disappearing
	Heavy political weight of the sector and professional networks, but with risk of social isolation	Little political weight and weak professional networks
Urban coastal zones With diversified economic activities (developing zones)	Fishing is structuring because it plays a major role in a dynamic area	Fishing may be important but hidden by other activities
	Political weight heavy but must communicate (or negotiate) with other sectors	Importance of inter-sectoral conflicts. Negative social image of sector and no political weight.

Source: Rey-Valette and Cunningham, 2003.

The social impact of a management measure (including individual transferable quotas) does not depend on its intrinsic nature but rather on the way in which it is implemented. This statement legitimises the need for a follow-up of institutional aspects.

3.4.3 Institutional Indicators

Recent interest in social impact of public policy relates to the recognition of the importance of institutional variables for growth. Besides the need for transparency, the importance of policy acceptability, related to the improved adaptation to social conditions and a greater appropriation through participation, has emerged as a major factor determining the efficiency of, and compliance with, policy. It should be noted that some of these issues may also be related to social aspects.

Public management policies' costs are estimated at around 2.5 millions US\$ for the OECD countries (36% of public transfer to the fishery sector), relatively equally shared between enforcement (39.6%), research (34%) and strictly management (26.4%). These services are provided by administration; very few countries transferred this activities to agencies or professional organisations. Although important variations are observed from one country to the other, management budgets represent a low proportion of landings value (average of 6% in 1997). These costs seem to be independent of variables such as the coastline length or the Exclusive Economic Zone (EEZ) size. At the opposite, they seem to be linked with landed volume, fleet size and management tools. Countries using a control of capture tool

have the lowest management cost. Governance systems have also an impact on management cost. Management costs increase as structures become more decentralised and participative. This result shows the limit of a strict cost analysis. Measures such as decentralisation or participative patterns of interactions need to be considered in a wider cost-efficiency approach, methodologically more complex.

At Mediterranean scale, the socio-economic group of the GFCM made a review of regulations in the Copemed countries:

- A review of policy framework related to fisheries and marine protected areas (2001);
- A comparative study on fishing regulations (2002); and
- A legislative and regulation reviews related to participative mechanism, planning and implementation (2003).

An abundant literature exists on the efficiency of management systems. Within this literature, Rudd (2004) has an interesting approach of an 'institutional framework for designing and monitoring ecosystem-based fisheries management policy experiments'. He proposes an IAD (Institutional Analysis and Development framework) adapted from Ostrom's works and integrated both in a PSR and sustainable livelihoods framework analysis. The modified IAD framework for ecosystem-based management includes five types of capital: natural, manufactured, human, social and financial. These categories are set to characterise types of pressure and to measure impacts. Aside from these types of capital, institutions (formal and informal), defined as 'rules in use', constitutes a determinant level of the analysis that influence stakeholders, incentives and behaviours.

4 CONCLUSION

It summary it can be concluded that only few socio-economic indicators are used on a routine basis. This particularly counts for social and institutional aspects of fisheries.

Considering the results of the concerted action 'Economic Assessment of European Fleets' and the obligation to provide to the Commission economic data on fleets, the European economic data set on fisheries is much more comprehensive than the social and institutional ones.

The establishment of indicators haven't followed the same path in biology and social sciences. This relates to the uses driving and the research supporting their development. Three phases in the process of establishing indicators can be distinguished:

- 1) reflection on a sustainable development framework;
- 2) analysis of mechanisms and processes impacting on sustainability with a disciplinary approach; and
- 3) analysis of mechanisms and processes impacting on sustainability with a multi-disciplinary approach.

Biology and other natural science research started to develop (very comprehensively) the phase 1 and are now developing the phase 2. Socio-economic research has focussed more on the phase 2, especially in relation to other research areas (eg ICZM and river basin management) whereas the phase 1, the sustainable development framework, hasn't been completed and still needs further consideration. In consequence the phases 1 and 2 need to be further developed to progress toward the

integration of natural and social sciences in phase 3. This is what the INDECO Concerted Action comes into play.

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ANNEX 1 ISSUES IDENTIFIED AND ACTIONS SUGGESTED BY THE EUROPEAN COMMISSION TO INTEGRATE ENVIRONMENTAL REQUIREMENT INTO THE CFP

(CEC, 1999, 2001a, 2001b, 2002)

Driving forces	Pressure related to fishing activity	State/Issues	Action proposed
	Fleet over capacity	Overfishing Low level of spawning populations	- adoption of management objectives in accordance with precautionary approach for commercially important fish stocks, non target species and habitats ;
	Overfishing	Food web changes	
	Physical effect of fishing on habitat in particular by beam trawling and otter trawling	Degradation of habitat (disturbance of sea beds, water column....)	- measure to avoid depletion of local, genetically distinct stocks ; - strengthening the implementation of existing and developing new technical conservation measures to reduce fishing impact on those components of ecosystems
	High harvest rate (?)	At long term potential changes in genetic diversity	
			Additional conditions
			Improving the level of coherence between CFP instruments and environmental instruments Enhance involvement of fishers in habitat restoration

ANNEX 2 EXAMPLES OF SUSTAINABLE DEVELOPMENT REFERENCE SYSTEM INDICATORS

(from FAO, 1999)

Dimensions	Pressure	State	Response
Environment (Ecosystem/ Resource)	<ul style="list-style-type: none"> · Total catch · Total area fished · Catch/sustainable yield · %resources > target F · Total effluent discharge 	<ul style="list-style-type: none"> · Biomass / target B · Fishing mortality / target F · Exploitation rate / target E · %target resource > target · %non-target resource > target · Biodiversity index · Community structure · Trophic structure · Area of critical habitat 	<ul style="list-style-type: none"> · TAC/sustainable yield · % depleted stocks rebuilding · Reduction in land-based pollution · User rights established · User fees established
Social	<ul style="list-style-type: none"> · Fishing effort · Number of vessels · Growth rate of number of fishers · Unemployment rate · Immigration rate · Social unrest 	<ul style="list-style-type: none"> · Number of fishers · Demography · Number of associations · % below poverty line · Income and asset distribution 	<ul style="list-style-type: none"> · Unemployment assistance · Support to associations · Resources allocation decision
Economic	<ul style="list-style-type: none"> · Sector unemployment · Subsidies · Excess fishing capacity · Resource rent potential 	<ul style="list-style-type: none"> · Profitability · Wages and salaries · Sector employment 	<ul style="list-style-type: none"> · Economic incentives and disincentives (eg subsidies, taxes, buy back) · Command and control measures
Institutions/ governance	<ul style="list-style-type: none"> · Employment policies · Absence of user or property rights 	<ul style="list-style-type: none"> · % resources assessed · % with management plans · % management cost recovery · Rate of 	<ul style="list-style-type: none"> · % resources assessed · Job conversion programmes · Retraining programmes · Number of compliance operations

Dimensions	Pressure	State	Response
		compliance · % ressources co-managed	

Indicateurs sectoriels de développement durable: le cas de la pêche continentale

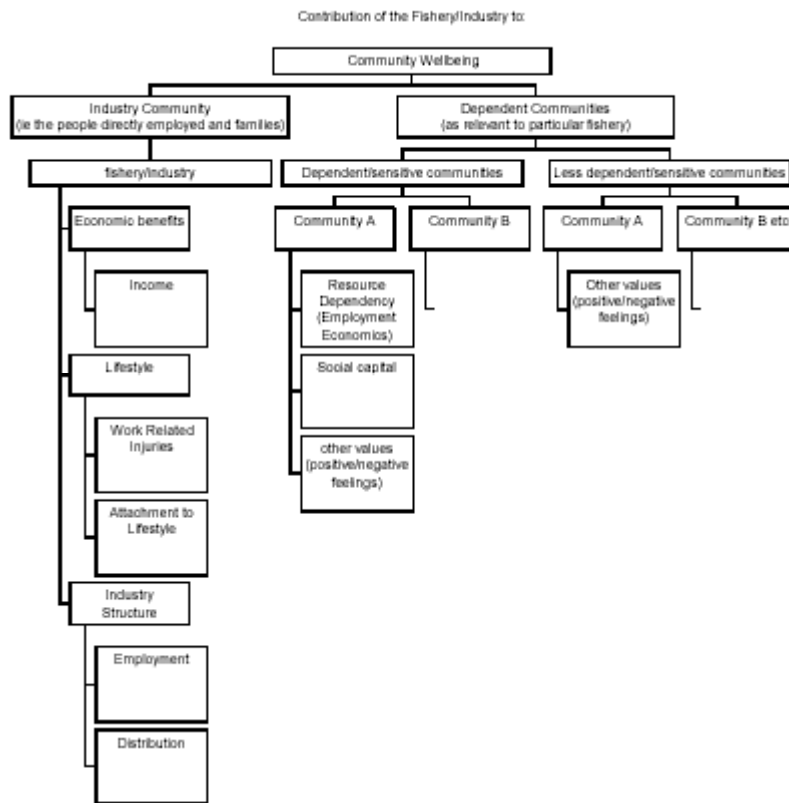
(source: Morand, 2000)

Domaine	Indicateurs
Indicateurs de suivi des milieux	
Conditions Hydro climatiques	Apports pluviométrique (Total des quantités mensuelles tombées) Puissance des crues (Hauteur d'eau sur des échelles de référence (moyenne du mois ou jours fixe) ; Débit (calculé en fonction de la hauteur ou issu de la télédétection)
Qualité des eaux	Turbidité (gène de la productivité) ; Présence de pesticides ; Concentration en en matière organique dissoute (rejets) et en germes colibaciformes , Demande biochimique en oxygène
Productivité des milieux	Dosage des sels nutritifs, phytoplancton et zooplancton
Productivité des milieux	Indicateur indirect de synthèse (par exemple profondeur)
Indicateurs halieutiques	
Pression d'exploitation (L'ensemble de ces indicateurs étant bien corrélés, un suffit)	Densité d'occupation selon l'effectif des pêcheurs (nombre de pêcheurs actif (entre 14 et 55 ans) par surface exploitable, données relatives à l'activité de pêche, capacité de pêche évaluée à partir du nombre d'embarcations, peu significatif pour la pêche continentale, effort de pêche : nombre de sorties, ou nombre d'hommes*heures ou bien nombre d'engins*heures : densité d'effort : effort par surface exploitable
Niveau de capture	Quantités totales débarquées (confrontation des suivi de débarquement, de commercialisation, de consommation) ; Estimation à partir de l'effort de pêche*PUE ; Rendement par unité de surface (Quantité/surface exploitable) Prise par unité d'effort (PUE) ; Structure des captures (% petite taille /total capture, poids relatif des espèces)
Indicateurs économiques	
Micro-économiques	Capital investi, prix des intrants, prix et recours main d'œuvre. Revenus (compte d'exploitation) Données ménages , stratégie de pêche, pluriactivité
Bio-économiques	Relation effort/coûts de pêche, revenus, rente

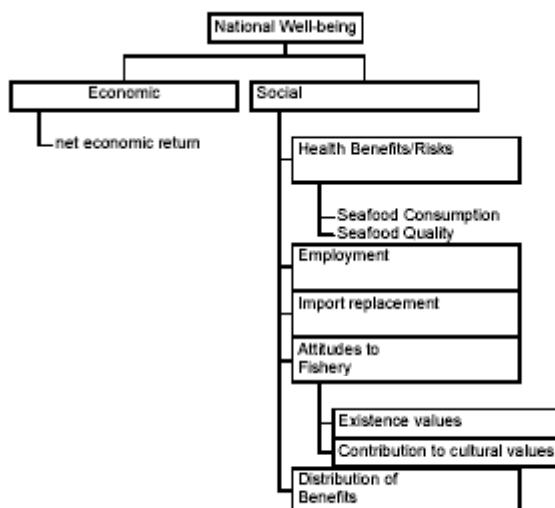
Domaine	Indicateurs
Filières de commercialisation	Densité des points de collecte, fréquence du ramassage, prix, marges et Va, qualité, investissement
Poids du secteur	PIB sectoriel, nombre d'emplois
Indicateurs démographiques	
Niveau démographique	Effectif moyen ; Composition des ménages
Origine population	Part des migrants ; Ancienneté d'occupation
Indicateurs sociologiques et institutionnels	
Droits d'accès	Type de mesure
Conflits	Conflits liés à des engins, conflits liés à des nationalités
Structure de gestion	Qualité de fonctionnement
Indicateurs de conditions de vie et de développement humain	
Pouvoir d'achat	Ration kg poisson/kg de riz
Accès aux soins	Taux d'accès
Etat sanitaire	Etat équipement
Mortalité infantile	% de mortalité
Scolarisation des enfants	Nombre d'enfants scolarisé, niveau moyen de diplôme

ANNEX 3 ECOLOGICALLY SUSTAINABLE DEVELOPMENT TREES

The Generic Component tree for community well-being



The Generic Component Tree for National Well-Being



ANNEX 4 A NEW ICES ADVISORY FRAMEWORK

In the context of developing a new ICES advisory framework and the broader context of integrative management it was suggested that the following definitions apply throughout all ICES advice on fisheries (ICES 2005):

Bias is the difference between the estimated and the True value of a parameter. Measures that are accurate have low bias.

Ecological Quality (EcoQ): An overall expression of the structure and function of the marine ecosystem taking into account the biological community and natural physiographic, geographic and climatic factors as well as physical and chemical conditions including those resulting from human activities.

Ecological Quality Objectives (EcoQO): The desired level of ecological quality relative to a reference level. The objective can be in relation to ecosystem health, structure, and function

Indicator means a property reflecting the status and changes of well-defined parts of an ecosystem, derived from observations, normally from monitoring programmes. There are in general two approaches to establishing an indicator: a) a single data series used as a proxy for system status and b) an aggregation of many individual series merged into a single value.

Limit Reference Point of an indicator is the point/value of the indicator to be avoided, since it is associated with a high risk of serious and irreversible harm to ecosystem.

Metric refers to the biological attribute that is being considered as an indicator of an ecological quality of the system. Metric and indicator can therefore be used interchangeably. The term metric was introduced to prevent confusion because indicator sometimes carries a specific meaning as an indicator species.

Objective without modifier means ecological, economic and social objectives.

Operational Ecosystem Objective means an Ecological Objective with sufficient specificity that the Indicator on which the Operational Ecosystem Objective will be measured can be selected readily, and the position of a corresponding reference point can be estimated.

Performance indicator is a decision support metric which has an unambiguous relationship with a manageable activity.

Reference Point means a specific value of an indicator associated with a particular objective.

Sensitive means technically, the magnitude of response of any indicator to some initial conditions of the system.

Surveillance indicator is a descriptive indicator describing environmental health.

Sustainable exploitation means the exploitation of a resource in such a way that the future exploitation will not be prejudiced and that it does not have a negative impact on the marine ecosystems.

Target Reference Point identifies states of the EcoQO (or, operationally, values of the metrics of the EcoQO) that management should be trying to maintain with high probability. The choice of the target level is a societal decision.

It was suggested (ICES 2005), that state indicators only apply to the ecosystem elements (Table 7) while pressure indicators (Table 8) could represent the status of a fishery (eg fishing effort) or fishery caused removals (eg landings). At the same time the state indicator could represent the status of the exploited stock while its change may be considered as an impact indicator.

Table 7 Potential ecosystem state indicators (ICES 2005)

ECOSYSTEM ELEMENT	SUBSET	ASPECT	INDICATOR
Physical habitat			Temperature Size of the area covered by a specific habitat
Water column and biochemical habitat			Nutrient levels Oxygen level Size of the area covered by a specific habitat Surface area of anoxia
Population	Assessed	Status stock	Recruitment (R) Spawning Stock Biomass (SSB) Yield Per Recruit (YPR) Fisheries mortality (F) Total mortality (Z) Exploitation rate (F/Z) Mean Age of the population
		Health	Condition factor Incidence of disease, pathogens, parasites, contaminants Genetic diversity
	Non-assessed	Status species	Total Biomass Total Number Presence of indicator, charismatic, sensitive species
		Health	Condition factor Incidence of disease, pathogens, parasites, contaminants Genetic diversity
Community	Size structure	Abundance	Slope size-spectra Mean weight or Mean length Proportion of large fish Length-frequency distribution <i>k</i> -dominance curves Multi-dimensional ordination

	Species composition	Abundance	Species presence / abundance Index of rare species Index of declining or increasing species Proportion of sensitive of threatened species Presence of Non-indigenous species Species turnover/loss rates Theoretical Distribution Metrics Log-Series and Log-Normal <i>k</i> -dominance curves Multi-dimensional ordination
	Species composition	Life-history	Mean maximum length Size above which 50 % of the population is mature Mean maximum age Age above which 50 % of the population is mature Fecundity expressed as number of eggs per female or number of eggs per body weight Mean <i>k</i> and/or L_{∞} of von Bertalanffy growth curve
Community		Biodiversity	Hill's N_0 N_1 N_2 Species-Effort Index Taxonomic Diversity Indices
Ecosystem		Production	Productivity P/B ratio Carbon per unit area/time/volume
		Trophic structure	Distribution of production among trophic levels, size classes, taxonomic groups Connectance or connectivity Path length Ratios of trophic levels
		Throughput	Internal consumption to yield Ulanowicz index
		Resilience	Return time of properties of food webs Invasibility

Table 8 Potential pressure indicators (modified from ICES 2005)

ACTIVITY	INDICATOR
Fisheries	Number of vessels Total engine power (Hp) Days-at-sea Hp Days-at-sea Hours fished Frequency with which an area is trawled Proportion of the area trawled with a specific frequency Total catch Total landings Total discards Total fisheries-induced mortality or direct mortality By-catches of protected species and discards

Rice and Rochet (2005) proposed fundamental indicator properties of concreteness, theoretical basis, public awareness, cost, measurement, historical data, sensitivity, responsiveness, specificity. The last three properties are especially relevant to describe the strength of the link with a manageable activity:

- Sensitivity - trends in the indicator should be sensitive to changes in the ecosystem state, pressure or response that the indicator is intended to measure
- Responsiveness - indicators should respond to the properties they are intended to measure rather than to other factors and/ or it should be possible to disentangle the effects of other factors from the observed response.
- Specificity - indicators should be responsive to effective management action and provide rapid and reliable feedback on the consequences of management actions.

Rice and Rochet (2005) have developed the framework for selecting a suite of indicators for fisheries management amended further by ICES (Table 9).

Table 9 A process for selecting indicators for fisheries management (ICES 2005)

1	Set operational management objectives based on existing policy commitments and knowledge of potential threats to sustainability (based on past and present experience and expectations for the future)
2	<u>Identify the human pressures</u> that may compromise each operational objective (based on past and present experience and expectations for the future)
3	<u>Rank human pressures</u> from high to low probability that they will compromise the achievement of objectives
4	Based on (3) <u>identify state indicators</u> (one or more) that are affected by these pressures and are most likely to compromise each objective. Specificity, complexity and number of indicators selected will reflect resources available for management.
5	<u>Identify/ develop potential pressure and response indicators</u> that may influence the value of each state indicator
6	Identify/ develop methods/ models that <u>link potential pressure to state and potential response indicators</u> (to predict whether and how changes in pressure and/ or response can be used to achieve a desired state)
7	If links described in (6) cannot be adequately described then <u>initiate relevant research</u>
8	Identify/ develop appropriate <u>monitoring programmes</u> for measuring the values of state, pressure and response indicators
9	Based on the operational objective, <u>set reference points, directions or trajectories</u> for each pressure, state and response indicator. Determine response times to specified changes in true values.
10	Confirm that it is feasible to meet reference points, directions or trajectories for all indicators <u>simultaneously</u> (and hence that is possible to meet all objectives simultaneously). Revise reference points, directions or trajectories if not.
11	If 4-10 cannot be completed for the indicators relating to an operational objective then <u>prioritise research</u> to improve existing indicators or identify new ones
12	<u>Repeat and review</u> process 1-11 regularly, to take account of new research and to continually improve the management system

According to ICES (2005) any of the ecosystem based fisheries management frameworks should include explicit objectives for both conservation of ecosystem components and attainment of social, economic and cultural benefits providing for natural association of state indicators with conservation objectives and pressure and impact indicators with social and economic indicators. Understanding and predicting the links between pressure, state and response through modelling the interrelationships among ecosystem attributes and components is seen to be crucial to developing a management system that supports the achievement of operational objectives (ICES 2005). Moreover, the application of the integrative management based on indicator framework require the knowledge on contribution of different sectors (activities) to each of the pressures concerned (Figure 4).

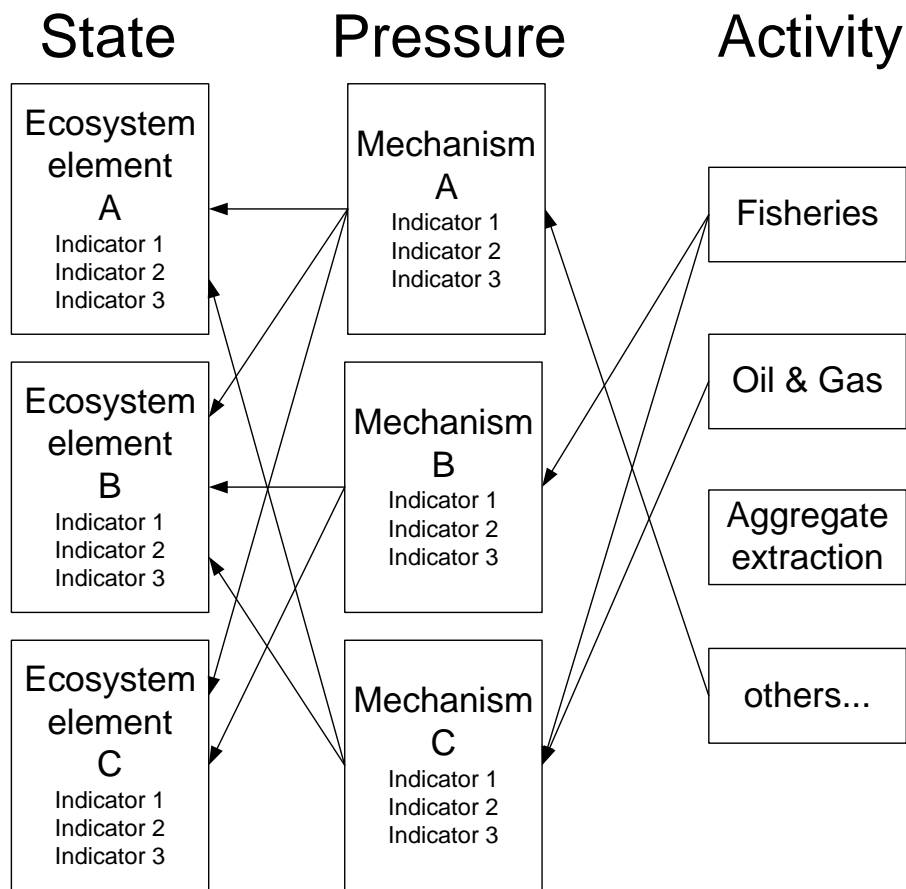


Figure 4 The use of indicators and their role to establish the links between states and pressures (ICES, 2005)

The strength of the relationship between a particular state indicator (ecosystem element) and a pressure indicator (mechanism) remains crucial when deciding whether that state indicator can be used within a management context given that the manageable unit should be that of the fishery or of any other activity concerned.

ANNEX 5 ACRONYMS

BAP	Biodiversity Action Plan for Fisheries
CFP	Common Fisheries Policy
DPSIR	Driving forces-Pressures-State-Impact-Response
EAF	Ecosystem Approach to Fisheries
EC	European Community
EEZ	Exclusive Economic Zone
ESD	Ecologically Sustainable Development
ESPON	European Spatial Planning Observation Network
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GFCM	General Fisheries Commission for the Mediterranean
IAD	Institutional Analysis and Development
ICES	International Council for the Exploration of the Sea
ICZM	Integrated Coastal Zone Management
ITQ	Individual Transferable Quotas
LAU	Local Administrative Unit
NGO	Non-Governmental Organisation
NUTS	Nomenclature of Territorial Units for Statistics
OECD	Organisation for Economic Co-operation and Development
PCI	Principle-Criteria-Indicators
PSR	Pressure-State-Response
SCESS	Sub-Committee on Economic and Social Sciences
SDRS	Sustainable Development Reference System
STECF	Scientific, Technical and Economic Committee for Fisheries
TAC	Total Allowable Catch